On the sixth day the sloughing sac was amputated. The patient made a good convalescence and was out of the hospital on the eleventh day. A few weeks later the cataracts were removed.

These patients are not considered so rare as they were ten or fifteen years ago, nor as poor surgical risks. There is wider knowledge of the possibility of their existence and a better acquaintance with the typical syndrome they produce. If the patient is in good physical condition, little fear is warranted in making a favorable prognosis. If the patient has become emaciated from inability to swallow food, then we have the task of building him up by feeding, and getting him in fit condition of nourishment before operating. In extreme cases a gastrostomy may have to be done preceding treatment of the diverticulum.

A surgical technic that will prevent leakage and infection is the next step. This has been accomplished, as stated before, by bringing the sac through and attaching it to the skin incision; ligating and amputating later.

With the above points in view, it would seem possible to perform radical operation in these cases of esophageal diverticulum with a small mortality rate, and with ultimate good results.

Merchants National Bank Building.

DISCUSSION

GEORGE THOMASON, M. D. (Hollingsworth Building, Los Angeles)—Doctor Moore has covered the ground so thoroughly that there is little left to be said. I have had a number of these patients in the past few years. One sign which has not been mentioned is that of a change in the contour of the neck, especially, of course, in the larger and more fully developed diverticula. As the patient swallows and the diverticula fills, there is a marked bulging of the neck on that side. With the regurgitation of the food and the emptying of the diverticula, the neck promptly returns to its normal appearance.

The chief reason why the traction diverticula are practically never of surgical importance, is that the opening into the esophagus is usually the lowest part of the diverticula and, therefore, empties readily and does not tend to increase in size or embarrass the function of the esophagus.

So far as operation is concerned, my personal experience has been with the Sippey-Bevan operation of puckering the sac and folding it upon itself accordion-like, thus collapsing the diverticula and plugging the opening with the sac itself.

One fundamental feature for success in any type of operation is to either keep the sac entirely closed as in the Sippey-Bevan operation, or do the two-stage operation of the Jackson-Gaub-Judd type. The absence of any serous coat on the esophagus means almost certain failure so far as immediate closure is concerned, and to open the sac before adhesions have formed around the site of operation is to court disaster from acute mediastinitis.

CHARLES D. LOCKWOOD (Citizens' Bank Building, Pasadena)—I wish to report briefly a case of diverticulum of the esophagus upon which I operated over twenty years ago. I think it is one of the first cases in which the x-ray and an opaque solution were employed for diagnosis.

The patient was a woman about 50 years of age, with a very large diverticulum in the cervical region. An x-ray was first taken with a stomach tube in the esophagus, through which a copper wire had been passed. The tube could not be passed into the stomach, but coiled up in the sac of the diverticulum. Later pictures, with a bismuth mixture filling the sac, gave an excellent outline and revealed the size of the diverticulum.

The patient became so emaciated from regurgitation of food that a gastrostomy was done before attempting removal of the diverticulum. She gained thirty pounds in weight after gastrostomy. The sac was then exposed through the neck, and partially removed. It was so large that complete removal was impossible. The remaining portion of the sac was plicated and its cavity greatly reduced. The patient remained well for several months and was able to swallow normally, but the diverticulum recurred and she finally died of starvation. In such extreme cases I believe gastrostomy is of great value.

JOHN HUNT SHEPARD, M. D. (San Jose)—A year ago, at our meeting in San Francisco, I read a paper before this Section on this same subject and reported two cases seen during the previous two years. Since then I have seen another case. I am confident that this condition is not as rare as we formerly considered it. These diverticula should be recognized before they attain a large size and seriously interfere with health. There is one point mentioned by Dr. Moore which I wish to emphasize, as I considered it the most important point in technique in all esophageal work. I refer to the use of the silk thread. With a little patience and perseverance it is possible to get the thread through any and every incomplete esophageal obstruction. Though at times it may be advisable to follow the thread with a linen fish-line, or even introduce over the thread a fine piano wire, once the silk is anchored in the intestine the continuance of the examination and treatment is rather easy. By the use of this technique, gastrostomy is practically never necessary. In all cases where caustics have been swallowed, the silk thread should be introduced before cicatricial contraction begins and kept in place until the degree of stenosis is determined. I agree with Dr. Moore that it is preferable to use a two-stage operation in all cases of large diverticula, but as these cases become recognized earlier, there will be fewer requiring the two-stage method.

ROENTGEN THERAPY OF UTERINE MYOMA DURING PREGNANCY

By JOHN D. LAWSON, M. D., *Woodland, Calif.*
(From the Department of Radiology, Woodland Clinic)

A review of the literature. Full report of one case. For literature reviewed, see Index Medicus or Cumulative Index, A. M. A.

Discussion of the value, indications and contra-indications of extensive roentgen treatment in the pregnant woman.

Pelvic irradiation of females who may become pregnant should be done with much care in selection of cases, and either only very light dosage employed or complete castration effected.

Pelvic irradiation of pregnant females should not be done except where there are very extenuating circumstances, and in any event the patient and her husband should be informed of the possibility, if not probability, of a deficient child.

Irradiation during the later months of pregnancy, if conclusions may be based on the results in six cases, is less injurious to the fetus than irradiation during the early months.

It would seem that the longer the elapse of time between irradiation and subsequent pregnancy, the greater is the probability of a normal child being born.

Radiography should be limited during pregnancy to the minimum.

Roentgen abortion or castration should never be performed except where there are definite reasons why the ordinary surgical procedures should not be followed.

There seems to be little difference between the actions of long and short waves on ova, either fertilized or unfertilized.

Additional evidence and opinions contained in the discussion by Francis B. Sheldon, Fresno; Kurt F. Behne, Los Angeles; Frederick H. Rodenbaugh, San Francisco.

THE selection of title was made hurriedly and unfortunately. Facts which should be brought out in reference to irradiation of the germ cells previous to fertilization, as well as other pelvic conditions treated during pregnancy by irradiation, are not included in the title, but I feel that it is best to

make the title a misnomer rather than to limit the scope of this paper conform to it.

Certain results observed by different men on irradiation of the male and female cells previous to their union have a direct bearing upon the result observed after irradiation following impregnation, and a consideration of one without the other would be incomplete.

The first work showing effect of irradiation upon fertilization of cells was probably done by F. Shaudinn in 1899, on protozoa. His article, however, did not cover the subject with any great accuracy, nor were his observations of any great value, except as a pioneer in the field.

Bohn, in 1903, described deformities and arrests in development of frog embryos resultant upon irradiation. His work was quite complete and well controlled, and is the first real scientific effort along this line.

Gilman and Baetjer, in the same year, reported results of experiments in which they irradiated the fertilizated ova of amblystoma. They noted particularly that there was at first an apparent stimulation in growth of the embryo and then a depression. There always was a resultant deformity characteristically of the head and brain.

Much experimental work continued, especially under the observation of Hertwig and his school, who did extremely painstaking work, especially on the semen of frogs and the eggs of seagulls and various nematodes. This school verified the observation of Gilman and Baetjer, especially on the resultant skull and brain injury.

Baldwin working with frog ova in 1919, Bagg in 1920, and Little and Bagg in 1923, working with mice, noted deformities of the products of the irradiated ova.

Bagg, in his work, irradiated female mice previous to impregnation, shortly after fertilization, and during the latter portion of the pregnancy, and found similarity in the results obtained by the three methods. He used in his experimental work radium emanation in three ways: first, as a gamma ray pack; second, subcutaneous injection; third, intravenous injection. The results were comparable in all three methods, the deformities observed consisting chiefly of injury to the head and neopallium and numerous areas of subcutaneous extravasation. Abortion was frequent in these cases, especially when the irradiation was given during the early part of the pregnancy. There did not seem to be any difference in the end-result of the irradiation of the female before fertilization and irradiation during pregnancy. The most common deformities were noted in the brain and eyes. Blindness being a very prominent feature of all these experiments.

Little and Snyder, in 1923, continued the work of Little and Bagg, but their observations did not allow them to verify the latter's work.

From a clinical standpoint, probably no therapeutic pelvic irradiations were given during pregnancy until 1914. No observations were registered in the literature until 1920, when Ashenheim reported a case in which the patient was given five irradiations for myoma between the second and the sixth months of gestation. The fruit of the pregnancy was a male child delivered at eight months, underweight and underdeveloped, showing a definite microcephaly, aplasis of the right optic nerve, atrophy of the left optic nerve, neuroretinitis, strabismus, mystagmus, and imbecility. This child was followed through the age of 6 years, and was definitely slow in development. The irradiation in this case was evidently of the short wave type, as the treatments were one hour each and included both a posterior and anterior field of application, other factors used not being noted.

Stettner, in 1921, reported a case of treatment for myoma during the second month of pregnancy, with the resultant delivery at eight months of an underdeveloped child, weighing 1850 grams, showing hypospadius, strabismus, neuroretinitis, and definite mental changes. At 2 years of age the child could not speak. The dosage in this case was also probably of the deep therapy type, copper filtration being used, and the castration dose of Seitz and Wintz being administered.

Berkeley, in 1921, reported a case of treatment of carcinoma of the cervix in a pregnant woman, the irradiation being administered in the sixth month of gestation. The patient was delivered at term by hysterotomy, a normal viable child being obtained. The only abnormalities noted were two bald spots on the child's head, corresponding to the site of application of the radium. This child was followed to 7½ years without any defects being noted, the hair coming in shortly after birth. Radium was used in this case, and the dosage totaled 3712 mgh., evidently chiefly gamma rays being used.

Field, in 1922, administered heavy irradiation during the sixth month of pregnancy to a patient with carcinoma of the cervix. The fetus was delivered normally in the eighth month, was apparently normal in all respects, except that it weighed but four pounds (1.8 kg.) at birth. At the end of three and one-half years reports indicated it was a healthy child. The treatment in this case consisted of 7320 mgh. of radium, only gamma rays being utilized.

Bailey and Bagg report two cases of pelvic irradiation during pregnancy. The first had carcinoma of the cervix on which both bare emanation tubes and gamma pack were used in the sixth month of gestation, the patient being delivered by hysterotomy for eclampsia in the eighth month. The child weighed four and one-half pounds (2 kg.) and was apparently normal, but died in ten weeks of pneumonia.

The second patient referred to in this article had an epithelioma of the vulva and was treated with both bare tubes and gamma radiation in the fifth month of gestation. A normal child was delivered at term by hysterotomy and was living and well at time of report.

These are the only authentic records of therapeutic pelvic irradiation during pregnancy which I have been able to discover. There is, of course, the work of Archangelsky, who in 1923 reported a series of therapeutic abortions chiefly for pulmonary tuberculosis. Ten cases, the duration of pregnancy being from one and one-half to four months, were

treated. In seven of the cases abortion resulted. The remaining three were not successful within the time observed, although none of them was allowed sufficient time to obtain a definite result, operative interference being instituted in each case shortly after the last treatment. Three pregnancies were noted in the series after abortion, but the results of these pregnancies were not noted. The factors used by Archangelsky were as follows: 2 Ma., 55 Kv., 1 mm. al, distance and time not stated, but an average dosage of 45 H. was used, evidently bringing the irradiation under the classification of long-wave therapy.

Probably the most important feature of Archangelsky's series has not been included in his report, namely, the results of the three pregnancies following therapeutic abortion.

Considering now the influence of pelvic irradiation of the female not pregnant, but with a reasonable possibility or probability of future pregnancy, we have numerous articles referring to this subject, and while, as was stated at the beginning, the title itself is not sufficiently broad to cover this phase, nevertheless it appears to me that the consideration of this angle of irradiation cannot be divorced from that of treatment during the gestation period.

Stacy, in 1922, reviewed the cases handled at the Mayo Clinic, the total of which was 1113, in which pelvic irradiation for various conditions was employed in women of all ages. This, of necessity, would include a large number of cases where there was no possibility of future pregnancy; it also presumably included a certain number of cases in which definite follow-ups could probably not be obtained. However, in this series Stacy reports ten pregnancies, and of this ten, four of the children were normal, and at the time of writing were living and well. Three of the pregnancies resulted in a stillborn fetus. Two of them miscarried, and one was pregnant at the time the article was written. This would give a percentage of, at the most, 50 per cent normal pregnancies. Stacy does not note after what type or amount of irradiation these pregnancies occurred, so that the influence of the amount and type of irradiation cannot be taken into consideration.

Werner, in review of his cases, 990 for essential metrorrhagia and 552 for myoma, notes that there were twenty-four pregnancies following irradiation; of these twenty-four, thirteen were carried to term with a normal labor and a normal living child as a product. One case was delivered normally about one month before term, the child being viable and normal. Nine cases aborted between the second and fifth months, three of these abortions being induced. One fetus was delivered by hysterectomy before term, the reason for the hysterectomy not being given. It is rather difficult to analyze Werner's statistics, as four of twenty-four cases were artificially terminated and the end product could not be, or was not, determined.

Clark and Keene, in 1922, reported a series of 527 cases of pelvic irradiation for various conditions, with seven pregnancies following irradiation. Out of these seven cases, only two were delivered at term of a normal child.

In Polak's series of treatment of menorrhagia in young girls, two pregnancies have been noted, the end-result of these pregnancies not being stated.

Steiger reports one case of pregnancy following a two-year period of amenorrhea after irradiation, with delivery of a normal child.

Of much interest is the case of Bailey and Bagg in which irradiation, by radium pack of the intrascapular region for glioma of the cord was administered in the third month of pregnancy with hysterotomy at term, a viable child being delivered. However, the child had a spina bifida and a double club-foot, and died at the end of fifteen days. A second case in their report is one of Hodgkins' disease, in which irradiation was given during May and December, 1917. The areas irradiated were neck, groins, back and axilla. Pregnancy began at about the time of the last irradiation, and the patient was delivered in September, 1918. The child had a malformation of the head with the sagittal suture open, exposing the brain and died in eleven hours.

These writers also report two cases of pregnancy following fibroid irradiation. The first became pregnant about nine months after treatment and was delivered of a large stillborn child. The second became pregnant one and one-half years after treatment and was delivered of a normal child at term.

It is probable that in all the cases cited all types of irradiation, including short wave and long wave therapy, were used, as the statistics extend over a sufficient length of time to include the periods of prevalence of both types of treatment.

We are, of necessity, considering two different conditions: First, the effect of irradiation on germ cells previous to fertilization and second, the effect of irradiation on the fertilized ovum in its different stages of development.

Under the first consideration, in view of the various reports, we must believe that the ova will be definitely disturbed in a high percentage of cases by irradiation. It is the contention of the German school that this disturbance, if irradiation is pushed to a sufficient degree, will result in destruction of the ova and graffian follicles, and that by this destruction the common results are obtained on all menorrhagias, metrorrhagias, and fibromyomata. The French school contends that these results, especially in the case of fibroids, are due to direct action on the tumor cells and endometrium. They do not, however, dispute the ovarian effect manifested by the cessation of menses and the production of distorted feti.

The second part of our statement would seem to be the one most difficult on which to draw any definite conclusion, in that only six clinical cases have been reported. If we can base our conclusion upon animal experimentation, there seems to be much evidence that definite developmental defects will be noted following fetal irradiation in utero; especially there seems to be proven by Archangelsky's work the fact that the pregnancy may be terminated during the first three months by irradiation of ovum and uterus. These experimental findings have been quite well borne out by the clinical evidence in the case reports cited.

This would necessarily bring up this question:

To how much exposure may be subject pregnant patients in radiographic work? Horner does not believe that there is any danger up to 3000 m. a. s., this being the limit in 250 cases which he had handled, each of which had had some radiography. He has never noted any influence of the exposure on the fetus. I have personally, in a number of cases, made gastro-intestinal examinations on pregnant patients in the first to eighth month of gestation, with exposure, chiefly abdominal, varying from 2000 to 4000 m. a. s., without noting any effect upon the fetus. There is, however, one case in my series in which there was a total exposure of about 5000 m. a. s., including a gastro-intestinal examination and two stereoscopic sets of the pelvis and fetus, one at seven months and one at about term.

In this particular instance, the child's birth weight was six pounds (2.7 kg.), and her progress has been very slow. She is now eleven months old and weighs slightly less than sixteen pounds (7 kg). There are no definite mental symptoms nor findings, but the child does not conduct herself as does the average child at the same age. She does not speak, is rather apathetic, and dentition has also been delayed.

I have never associated the amount of radiographic exposure in this case with the child's deficiency. However, in view of the literature noted in the preparation of this paper, I believe that the exposure was a definite etiologic factor in the underdevelopment of this child.

We may only speculate on the influence of irradiation on the general development and well-being of the child noted above. However, it has been my good fortune to observe one case of particular interest in which I am certain x-rays played a part in the production of a child below normal—not permanently, but for the first two years. Acknowledgement is hereby made of the assistance of Dr. M. P. Burnham and Dr. F. H. Rodenbaugh of San Francisco in the handling of this case.

Mrs. A., housewife, age 29. April 10, 1921. *Family history*—Negative. *Past history*—Nothing of significance except the history of being a bleeder. *Menstrual history*—Began at thirteen, regular, with severe dysmenorrhea until a few years ago, flow lasts six to seven days, profuse first two days. Last period began December 22, 1920; was normal. Expected date of confinement September 29, 1921. *Previous pregnancies*—None. Married in 1914. *Abnormalities during present pregnancy*—Except for usual nausea and slight show of blood on March 14, patient was well until one week ago, when she had an attack of pain in region of left scapula, suggestive of acute pleuritis. Three days later pain appeared in pelvis and involved both sides, more marked on left, radiating down left leg. Pain was very severe and had to be controlled with morphine.

Physical Examination—Young woman of slight build, rather undernourished and anemic in appearance. General condition fair. Fundus about two fingers below umbilicus and pushed to right, where patient states it has been for some time. Mass about size of a large grapefruit felt just above pubis; firm, but not nodular. Another mass, movable, about size and shape of a medium-sized banana on left side attached low and extending upward. Abdomen very tender and sensitive, especially over tumor masses. *Vaginal examination*—Cervix hard, showing round tumor mass as above described; cervical canal not located; impossible to insert finger between tumor mass and pubis; small movable mass to the left and passing upward toward cul-de-sac, about three centimeters in length and two centimeters in diameter. The whole uterus has been pushed, or drawn, as the case may be, upward until its actual size cannot be exactly ascertained. The whole abdominal and pelvic structures are tender and sensitive to touch. *Diagnosis*—Multiple fibromyomata complicating a pregnancy of about four months. *Comment*—The factors in all irradiations were as follows: Ninety Kv—5 ma—12 minutes FSD 25 cm.—Filter 5 mm. al. Both anterior and posterior fields were used. *April 19*—After roentgen treatments on April 15, 16, and 18, patient states that pain has been markedly relieved. *April 24*—Pain has been absent for several days, no symptoms whatsoever. Patient eats and sleeps well, gaining in health. *May 10, 1921*—Patient states she has been free from pain for past two weeks; feeling very well, and can perform her usual household duties. Another irradiation given on this date.

Abdominal Examination—Abdomen only slightly tender, and that on deep pressure over tumor masses. Tumor mass which involves the cervix has decreased slightly in size. All other tumors decreased considerably. Patient was able to come to the office alone for examination. *May 12*—Irradiation. *June 8*—No pain since last examination, eats and sleeps well, no discomfort whatsoever. Fetal movement marked and vigorous. Patient states that she first felt fetal life on May 18. *Physical examination*—Shows cervical tumor mass about size of an orange, all other tumor masses not palpable. *Vaginal examination*—Cervix has not regained its identity, but is not so hard and not sensitive. Uterus is coming down farther into pelvis, two fingers can be inserted between tumor mass and pubis. *September 26, 1921*—Since last record, patient has had some pain, never extremely severe, mostly in left lower quadrant. She has gained from 115 pounds to 145 pounds in weight, and general condition has been good.

Physical Examination—Blood pressure, 120-60. Fundus to thirty-eighth week. Tumor mass rather soft at cervix, about the size of an orange. One tumor mass about 5 cm. in diameter, and 2 cm. thick just in front of head in left lower quadrant.

Operation—September 27, 1921. Median incision. Conservative Cesarean section, subserous myomectomy.

Findings—Uterus found twisted to left with right tubo-uterine junction anteriorly. Exploration revealed about eight small subserous myomata scattered over uterus, ranging in size from a pea to a walnut. One large myoma about 6 cm. in diameter and 9 cm. long at the left and including the cervix. In cutting through the uterine wall, it was noted that the thickness was greater than normal, and quite fibrous. A female child was delivered, and breathed before the cord was severed. Four of the largest and most prominent myomata, exclusive of the large cervical tumor, were removed, being easily enucleated. Due to the fact that patient wished to become pregnant if possible, and also that the blood loss had been much greater than in the average case, it was deemed advisable to allow the uterus to remain, as total hysterectomy would have been necessary to remove the large myoma.

Except for a moderate rise in temperature for the first seven days post-operative, her convalescence was uneventful and she returned home sixteen days from the time of her operation, in as good a condition as the average Cesarean section at this time. The child was apparently normal, weight five pounds (2270 grams), cried vigorously, nursed well and conducted itself as a normal infant should. The myoma remained regressed somewhat, but there was some pelvic pain, and further irradiation was administered on the following dates: October 30; November 8, 15, 23, 28; December 6 and 13, 1921; and January 17, 1922, the factors being the same as in the previous treatments except the time was decreased to eight minutes, and the voltage increased to 105 Kv.

The myoma following these treatments disappeared entirely, and the patient was in excellent health six months after delivery. Her menses had not appeared at this time.

The child at this time, however, was rather frail and anemic, and while there was no definite deviation from normal, she was below par physically and mentally.

All effort to establish direct communication with this patient since that time has been fruitless, but the observation of a colleague six months ago was to the effect that

the child was at least one year mentally and physically backward.

Dr. Rodenbaugh informs me that he has very recently observed both mother and child. The child, to all intents and purposes, is normal. The mother's general condition is excellent; her menses have returned and all myoma are absent, the uterus being small and fibrous.

CONCLUSIONS

1. Pelvic irradiation of females who may become pregnant should be done with much care in selection of cases, and either only very light dosage employed or complete castration effected.

2. Pelvic irradiation of pregnant females should not be done except where there are very extenuating circumstances, and in any event the patient and her husband should be informed of the possibility, if not probability, of a deficient child.

3. Irradiation during the later months of pregnancy, if conclusions may be based on the results in six cases, is less injurious to the fetus than irradiation during the early months.

4. It would seem that the longer the elapse of time between irradiation and subsequent pregnancy, the greater is the probability of a normal child being born.

5. Radiography should be limited during pregnancy to the minimum.

6. Roentgen abortion or castration should never be performed except where there are definite reasons why the ordinary surgical procedures should not be followed.

7. There seems to be little difference between the actions of long and short waves on ova, either fertilized or unfertilized.

DISCUSSION

FRANCIS B. SHELDON, M. D. (Mattei Building, Fresno, Calif.)—This very interesting paper shows much work. However, it seems to me that we have not yet done enough work on this subject to form very definite conclusions. Certainly, we will all agree that the fetus in utero should not be exposed to more than a minimum of ray with which we may accomplish the purpose for which we are making the exposure. We should not accuse the ray of results, when we do not uniformly get those same results following exposure to the ray. There is much filtration of the ray before it will reach the fetus in utero.

Very often in families where there are several children we will see one or another that will apparently be more backward than others. Or they may not grow and develop as rapidly as some of the others. Families in which this occurs may never have been near an x-ray. We have not determined the reason of this backwardness in one child and not in the others. Until this is determined, how are we to have perfect controls to determine the actual lesion that may be produced by the ray? There has been no fetal lesion reported following radiation that cannot be found where no radiation has been given. We have all rayed pregnant women and seen no ill-results in the child after delivery.

Until we have ruled out all the causes for the deformities and backward conditions in children, we should not be too hasty in placing the blame for these things on the x-ray. This does not eliminate caution in our work. In the case reported, can we definitely say that the condition for which the radiation was given was in no way responsible for the temporary backward development of the child? I do not believe that we should blame the ray for results that are more or less common without its use.

KURT F. BEHNE, M. D. (Soiland Radiological Clinic, Los Angeles)—The very interesting article of Dr. Lawson touches a problem which is, next to the treatment of cancer, the most important one in modern radiation deep therapy. It is an established fact that we are able to produce the menopause by roentgen or radium rays at any age of the patient without causing any damage to the skin or to any internal organs. The observation of patients who have undergone this treatment during the last ten years has proven that the after effects of the "radiation-menopause" do not differ from the bodily changes happening during the course of the natural menopause. The experiences in Dr. Soiland's Radiological Clinic corroborate this.

Provided a proper indication is present for an artificial menopause, we are justified in producing it by the rays without restriction in cases of women who are nearing the menopause. The question is whether we are generally entitled to cause the "radiation-menopause" in women who are still in the child-bearing age. Of course, we are allowed to stop the menstruation permanently by the radiation treatment in younger women as is the surgeon who extirpates both ovaries, provided there is a proper indication for this treatment. Another question is whether we are allowed to give the patient the radiation treatment in cases in which the surgeon is able to relieve the condition by a conservative operation, not disturbing the function of the ovaries, as, for instance, in cases of myomectomy. The experience of Gauss, Seitz, Wintz and other authors has shown that we can obtain, in proper cases, the same results as the surgeon with his conservative operation without endangering the life of the patient and without hospitalization, by the "temporary stopping of the menstruation" for a half year or longer with the administration of an adequate roentgen ray or radium dose. Within this time the diseased condition of the genital organs clears up (myoma, irregular and excessive menstrual flow, inflammation, etc.) and the patient again starts menstruating normally.

Up to the present time, there has been no damage observed in the children borne by women with regularly functioning ovaries after such a temporary stopping of the menstruation with the radiation treatment. The biological happening in the ovaries after the absorption of such a small radiation dose and the harmlessness of this dose as to future pregnancies can be easily explained. There is a difference in the radiation sensitiveness of the various stages of evolution of the ova. The primordial follicles are apparently much less sensitive to the rays than the Graafian follicles. The small dose of rays destroys the function of the Graafian follicles, but does not affect in any marked degree the less sensitive primordial follicles. As soon as the slightly disturbed primordial follicles have developed into Graafian follicles, the normal function of the ovaries starts again and the menstruation again appears. It is evident that the ripe ova which originate from these follicles have not been affected by the small radiation dose which was necessary for the temporary stopping of the menstruation. The appearance of an entirely normal menstruation shows also that there is no longer a disturbance of the function of the ovaries, and for these reasons any fears of finding either bodily or mental disturbances in a child born after such a radiation treatment of the mother are without foundation.

I agree with Lawson that the administration of rays should be done only in cases where it is properly indicated. I think, however, we should use the rays more extensively in cases of benign diseases of women in the child-bearing age instead of surgery.

The case of Stettner, referred to by Lawson, is well known to me, Professor Stettner, Erlangen, being a personal friend of mine. The patient had been treated in our University Women's Hospital in Erlangen, Bavaria. What Sheldon says in his discussion applies also to this case. It cannot be positively determined whether the disturbances of the child are due to the x-ray treatment or due to other unknown causes. A myomatous uterus as such is liable to cause failures of development in a child.

FREDERICK H. RODENBAUGH, M. D. (516 Sutter Street, San Francisco)—The patient referred to by Dr. Lawson was observed by me during treatment, and observed two years following treatment, shows two distinct phases of the effects of radiation:

First, the difficulty with moderate radiation in producing complete and permanent amenorrhea in young women. The restoration of the menses in varying periods of time following treatment is the rule in young women.

The child at this age does not present any marked mental or physical stigmata to differentiate it from the average child of its age.

I was most reluctant to treat a pregnant uterus, and was only induced to do so when an abortion was imminent, and while my personal experience is limited to two cases, neither of them received massive radiation, and I was fortunate in not producing deformities in the children. I believe that the administration of heavy radiation to pregnant uteri will conform to experimental data, and produce defective offspring. I do not believe that I will personally administer therapeutic doses to any pregnant uterus in the future.

It should be clearly understood, however, that there is no danger in the use of the ordinary diagnostic measure, and an impression should not be given to the general profession that harm will result from diagnostic procedures.

Doctor Lawson is to be congratulated on his clear presentation of the subject, and his careful review of the literature, and I fully concur with his conclusions.

DOCTOR LAWSON (closing)—It has pleased me very much to have a full discussion on this paper, inasmuch as I have experienced very much interest in the collection of the data which has been put into the article.

I fully agree with Sheldon in his statement that there has been no fetal lesion reported following the irradiation that cannot be found where no irradiation has been given, but I really feel that the incident of fetal lesions is infinitely greater in cases where irradiation has been given than in cases not so treated. I think this opinion is verified by the literature.

Behne states: "Up to the present time there has been no damage observed in the children borne by women with regularly functioning ovaries after such a temporary stopping (by irradiation) of the menstruation."

This, however, is not borne out either by experimental data or by cases cited in this paper, especially the work of Clark and Keene, Werner and Stacy. There is no doubt that we are in the dark to a great extent as to results directly traceable to irradiation and the many variable conclusions bear witness to this fact.

DIPHTHERIA IMMUNIZATION

By ABRAHAM METZNER, M. D., *Los Angeles*

The increased and increasing knowledge of diphtheria should be constantly utilized by all physicians.

It is as much a physician's duty to prevent his clients from contracting diphtheria as it is to treat them after they have it.

Preventive methods are simple and certain, and can be used by any intelligent physician in his office.

DISCUSSION *by William C. Hassler, San Francisco; Langley Porter, San Francisco; Clifford D. Sweet, Oakland; Edgar Brigham, Dinuba; J. W. Morgan, Modesto; J. D. Dunshee, Los Angeles.*

DIPHTHERIA is still one of the most dreaded diseases and one of the most frequent causes of death in early childhood, and it is a fact that the discovery and use of antitoxin has materially reduced this death rate. The death rate has dropped from about 65 per cent to about 10 per cent. At this latter figure it has remained, in spite of our clearer knowledge of the disease and improvements in diagnosis and treatment. That no further decrease in the death rate has occurred, is due to the human agencies rather than to limitation of the value of antitoxin. The poor resistance of patients, their inability to manufacture a natural resistance, and the too frequent failure in early administration of sufficient antitoxin are among these causes. B. S. Roberts of the New York State Health Department found, in an analysis of over 500 deaths from diphtheria, that the death rate is practically nil when adequate treatment is given on the first day of the disease. This has been corroborated by others. The fact also remains that, when contacts are given antitoxin as an immunizing agent, the period of immunity is brief, no provision being made for susceptible contacts who are not discovered. The carrier problem is also present. Atypical and nasal diphtheria often pass unnoticed. Antitoxin is not entirely without danger, and deaths from its use, though few, have occurred. It will thus be seen that further measures are extremely necessary. Thanks to the work of Behring, Schick, and others, the dangers from additional factors can be aborted, and diphtheria so controlled that, eventually, it will become one of the diseases more rarely seen.

Lesions of diphtheria, both local and general, are due to the action of a soluble toxin secreted by the Klebs Loeffler bacillus. How they act is still a moot question. Recovery takes place through the formation of antitoxin by the body cells, which neutralizes the toxin. That permanent immunity is not produced by the disease is evident, in that two or three attacks are not very uncommon. A natural immunity is frequently present at birth and may last through life. Von Groer and Kassowitz found that those mothers who had a natural immunity were able to transmit this immunity to their offspring, while the 16 per cent of the mothers who did not possess this immunity had offspring who were not immune. These findings were more recently corroborated by Ruh and McClelland. This immunity, however, is lost in fully 85 per cent of the infants by the age of six months. Those losing this immunity reacquire it in a progressively increasing number as they grow older, but, as a rule, it is not reacquired before the ninth year, thus leaving them vulnerable during the most susceptible age group between six months and nine years.

The problem then remains to separate the immune from the susceptible and to immunize the non-immune. In 1913, Bela Schick proposed a very simple method of separating these groups based upon the observations of von Behring. Schick discovered that when 1/50 of an M. L. D. for guinea pigs weighing 250 grams was injected, intracutaneously, in a human being in whom there was 1/30 or more of antitoxin per cubic centimeter of serum, no reaction followed. If less than this amount, or none at all was present, it produced an inflammatory reaction at the site of the injection. This inflamed area persists for four days or more, and should not be confused with a somewhat similar reaction which may be produced by the protein found in the diluent, and which disappears within twenty-four or thirty-six hours. Von Behring, following the method used by Park and others in immunizing animals, showed that the same procedure could be safely used in humans. In 1920, Bieber published a history of 1097 children who had been immunized by Hahn and Sumner, in the village of Madgeburg in 1913, showing that of those who had received full treatment of toxin-antitoxin, only 3.3 per cent later developed diphtheria, while of those who had not been immunized, 15 per cent developed the disease, thus reducing the incidence by approximately 80 per cent.

From that time on, there has been an increasing